What Is Claimed Is:

1. A method of motion estimation and compensation processing, comprising:

determining a preliminary motion vector from a set of partial motion vectors each associated with a corresponding subsampled matchblock representing a given picture;

generating a second motion vector based on a refined granularity of the preliminary motion vector; and

performing a fractional pixel search using the second motion vector to produce a final motion vector, the final motion vector being used for motion compensation.

2. The method of motion estimation and compensation processing according to Claim 1, wherein determining a preliminary motion vector, comprises:

dividing the matchblock associated with the given picture into a plurality of first sub-blocks;

dividing a search area associated with a reference picture into a plurality of second sub-blocks, the second sub-blocks being divided by a factor similar to that used to divide the first sub-blocks;

duplicating one of the first sub-blocks over each of the second sub-blocks; and

determining a set of best matches between a respective sub-image in each of the first sub-blocks and a sub-image in each corresponding one of the second sub-blocks, the set of best matches representing the set of partial motion vectors.

3. The method of motion estimation and compensation processing according to Claim 2, wherein the first sub-blocks each comprises a Q x Q array of pixels subsampled from the matchblock, and the second sub-blocks each comprises an M x M array of pixels.

4. The method of motion estimation and compensation processing according to Claim 3, wherein M = 16 and Q = 4.

5. The method of motion estimation and compensation processing according to Claim 3, wherein Q = 19 for bidirectionally predicted coded (P-type) pictures that are in sequence previous to and subsequent to the reference picture.

6. The method of motion estimation and compensation processing according to Claim 3, wherein Q = 19 for left and right portions of the given picture, when in a predicted coded (P-type) format.

7. The method of motion estimation and compensation processing according to Claim 2, wherein determining a set of best matches comprises:

performing exhaustive searches in parallel for each of the first sub-blocks over each respect one of the second sub-blocks.

8. The method of motion estimation and compensation processing according to Claim 7, wherein performing exhaustive searches in parallel comprises:

calculating a partial sum of absolute distance (Psad) between coordinate positions of one first sub-block and a corresponding one of the second sub-blocks.

9. The method of motion estimation and compensation processing according to Claim 8, wherein the Psad is determined from

$$\mathrm{Psad}_{i,j} = \sum_{i,j=0..3} \left| \mathrm{match}_{i,j} - \mathrm{ref}_{i,j} \right|,$$

wherein i represents an x coordinate position, j represents a y coordinate position, $\mathrm{match}_{i,j}$ represents a first sub-block, and $\mathrm{ref}_{i,j}$ represents a second sub-block.

10. The method of motion estimation and compensation processing according to Claim 7, wherein performing exhaustive searches in parallel comprises:

contemporaneously moving each of the second sub-blocks relative to each corresponding first sub-block to a next location; and

calculating a partial sum of absolute distance (Psad) between coordinate positions of one first sub-block and a corresponding one of the second sub-blocks.

11. The method of motion estimation and compensation processing according to

Claim 1, wherein generating a second motion vector based on a refined granularity of the preliminary motion vector, comprises:

obtaining the matchblock associated with the given picture;

enlarging a first search area to generate a second search area, the first search area being associated with a reference picture and used to determine the set of partial motion vectors; and

determining a best match between a respective sub-image located in the matchblock and a sub-image that is identical to the respective sub-image and that is located in the second search area, the best match representing the second motion vector.

12. The method of motion estimation and compensation processing according to Claim 11, wherein determining a best match comprises:

performing an exhaustive search for the respective sub-image over the second search area.

13. The method of motion estimation and compensation processing according to Claim 12, wherein performing an exhaustive search, comprises:

calculating a partial sum of absolute distance (Psad) between a coordinate position associated with the matchblock and a corresponding coordinate position associated with the second search area.

14. The method of motion estimation and compensation processing according to Claim 13, wherein the Psad is determined from

$$\text{Psad}_{i,j} = \sum_{i,j=0..3} \left| \text{match}_{i,j} - \text{ref}_{i,j} \right|,$$

wherein i represents an x coordinate position, j represents a y coordinate position, $\text{match}_{i,j}$ represents the matchblock, and $\text{ref}_{i,j}$ represents the second search area.

15. The method of motion estimation and compensation processing according to Claim 13, wherein performing an exhaustive search, comprises:

for each coordinate position associated with the matchblock, calculating a partial sum of absolute distance (Psad) between each said coordinate position and all coordinate positions associated with the second search area.

16. The method of motion estimation and compensation processing according to Claim 11, wherein the matchblock comprises an M x M array of pixels, the first search area comprises a Q x Q array of pixels, and the second search area comprises an $Q\pm2$ x $Q\pm2$ array of pixels, where $Q \alpha M/4$.

17. The method of motion estimation and compensation processing according to Claim 16, wherein M = 16 and Q = 4.

18. The method of motion estimation and compensation processing according to Claim 1, wherein performing a fractional pixel search using the second motion vector to produce a final motion vector, comprises:

obtaining the matchblock associated with the given picture;

enlarging a first search area to generate a second search area, the first

search area being associated with a reference picture and used to determine the second motion vector;

determining a half-pixel predicted reference macroblock associated with the second search area; and

determining a best match between a respective sub-image located in the matchblock and a sub-image that is identical to the respective sub-image and that is located in the second search area, the best match representing the second motion vector.

19. The method of motion estimation and compensation processing according to Claim 18, wherein determining a best match comprises:

performing an exhaustive search for the respective sub-image over the second search area.

20. The method of motion estimation and compensation processing according to Claim 19, wherein performing an exhaustive search, comprises:

calculating a partial sum of absolute distance (Psad) between a coordinate position associated with the macroblock and a corresponding coordinate position associated with the second search area.

21. The method of motion estimation and compensation processing according to Claim 20, wherein the Psad is determined from

$$\underset{i,j=0..3}{Psad_{i,j}} = \Sigma \left| match_{i,j} - ref_{i,j} \right|,$$

wherein i represents an x coordinate position, j represents a y coordinate position, $match_{i,j}$ represents the matchblock, and $ref_{i,j}$ represents the second search area.

22. The method of motion estimation and compensation processing according to Claim 19, wherein performing an exhaustive search, comprises:

for each coordinate position associated with the macroblock, calculating a partial sum of absolute distance (Psad) between each said coordinate position and all coordinate positions associated with the second search area.

23. The method of motion estimation and compensation processing according to Claim 18, wherein the matchblock comprises a 16 x 16 array of pixels, the first search area comprises a 4 x 4 array of pixels, and the second search area comprises a 18 x 18 array of pixels.

24. The method of motion estimation and compensation processing according to Claim 1, further comprising:

determining residual data associated with the final motion vector; and

reconstructing a video signal for encoding based on the residual data and the final motion vector.

25. The method of motion estimation and compensation processing according to Claim 24, wherein determining residual data ($residue_{ij}$) associated with the final motion vector, comprises:

determining match data ($match_{ij}$) for Y, U, and V components of the given picture; and

calculating prediction data ($pred_{i,j}$) of a reference macroblock ($ref_{i,j}$) associated with a half pixel search.

26. The method of motion estimation and compensation processing according to Claim 25, wherein the $pred_{i,j}$ is determined according to

$pred_{i,j}$ =

$(ref_{i,j} + ref_{i,j-1} + 1) >> 1$; or
$(ref_{i,j} + ref_{i,j+1} + 1) >> 1$; or
$(ref_{i,j} + ref_{i-1,j} + 1) >> 1$; or
$(ref_{i,j} + ref_{i+1,j} + 1) >> 1$; or
$(ref_{i,j} + ref_{i,j-1} + ref_{i-1,j} + ref_{i-1,j-1} + 2) >> 2$; or
$(ref_{i,j} + ref_{i,j-1} + ref_{i+1,j} + ref_{i+1,j-1} + 2) >> 2$; or
$(ref_{i,j} + ref_{i,j+1} + ref_{i+1,j} + ref_{i+1,j+1} + 2) >> 2$; or
$(ref_{i,j} + ref_{i,j+1} + ref_{i-1,j} + ref_{i-1,j+1} + 2) >> 2$,

wherein i represents an x coordinate position and j represents a y coordinate position of the reference macroblock.

27. The method of motion estimation and compensation processing according to Claim 26, wherein the residual data is determined by

$$residue_{i,j} = match_{i,j} - pred_{i,j} \quad i,j = 0..15$$

28. The method of motion estimation and compensation processing according to Claim 27, wherein reconstructing a video signal for encoding based on the residual data and the final motion vector, comprises reconstructing the macroblock data according to

$$reconstructed_{i,j} = residue_{i,j} - pred_{i,j}.$$

$i,j = 0..15$

29. The method of motion estimation and compensation processing according to Claim 27, wherein reconstructing a video signal for encoding based on the residual data and the final motion vector, comprises performing decompensation to reconstruct the macroblock data based on the residue data and the prediction data.

30. A computer-implemented method of motion estimation processing, comprising:

dividing a matchblock of a current frame into a plurality of sub-matchblocks, the current frame to be encoded;

dividing a first search area of a reference frame into a plurality of search sub-blocks;

replicating a sub-matchblock over each of the search sub-blocks;

performing partial pixel level searching in parallel of each sub-matchblock replicated over the search sub-blocks to generate a preliminary motion vector;

modifying the first search area to produce a second search area;

performing full pixel level searching of the matchblock over the second search area to generate a second motion vector, the second motion vector being of finer granularity than the preliminary motion vector; and

performing half pixel searching on the second motion vector to produce a

final motion vector used for motion compensation.

31. The computer-implemented method of motion estimation processing according to Claim 30, further comprising:

determining residual data and prediction data associated with the final motion vector; and

reconstructing a video signal for encoding based on the residual data and the prediction data.

32. A video compression system, comprising:

a processor-based platform coupled to a bus subsystem; and

coupled to bus subsystem, a front end subsystem having at least a motion estimation and compensation (MEC) engine coupled to a stream buffer.

33. The video compression system according to Claim 32, wherein the MEC engine includes:

an A x B array formed from a plurality of cells coupled to a set of controllers and an end column processor.

34. The video compression system according to Claim 33, wherein the A x B array includes:

a M x N sub-array of p_cells; and

coupled to the p_cells, a plurality of boundary cells bounding the M x N

sub-array.

35. The video compression system according to Claim 34, wherein the boundary cells include:

a plurality of updown cells disposed along a first set of opposing sides of the M x N sub-array of p_cells;

a plurality of io cells facing a plurality of column cells, the io cells disposed along one side of a second set of opposing sides of the M x N sub-array of p_cells, and the column cells disposed along the other side of the second set of opposing sides of the M x N sub-array of p_cells; and

a plurality of corner cells coupled to the updown cells.

36. The video compression system according to Claim 35, wherein N = 5, and M = 20, A = 7, and B = 22.

37. The video compression system according to Claim 33, wherein the set of controllers includes an x-controller and a y-controller each having respective control lines coupled to the MEC array to form an MIMD arrangement.

38. The video compression system according to Claim 33, wherein the end column processor receives output signals from the MEC array.

39. The video compression system according to Claim 32, wherein said system is included in one of a PC camera, digital camera, personal digital assistant (PDA),

multimedia cellular mobile phone, digital video recorder (DVR), and multimedia device and appliance.

40. The video compression system according to Claim 32, wherein said system is included in one of an SoC and an ASIC applications.

41. A computer program product for motion estimation and compensation, the computer program product stored on a computer readable medium, and adapted to perform operations of:

determining a preliminary motion vector from a set of partial motion vectors each associated with a corresponding subsampled matchblock representing a given picture;

generating a second motion vector based on a refined granularity of the preliminary motion vector; and

performing a fractional pixel search using the second motion vector to produce a final motion vector, the final motion vector being used for motion compensation.

42. A computer program product for video compression processing, the computer program product stored on a computer readable medium, and adapted to perform operations of:

dividing a matchblock of a current frame into a plurality of sub-matchblocks, the current frame to be encoded;

dividing a first search area of a reference frame into a plurality of search

sub-blocks;

replicating a sub-matchblock over each of the search sub-blocks;

performing partial pixel level searching in parallel of the sub-matchblocks replicated over the search sub-blocks to generate a preliminary motion vector;

modifying the first search area to produce a second search area;

performing full pixel level searching of the matchblock over the second search area to generate a second motion vector, the second motion vector being of finer granularity than the preliminary motion vector; and

performing half pixel searching on the second motion vector to produce a final motion vector used for motion compensation.

43. A video processing system providing motion compensation, comprising:

means for determining a preliminary motion vector from a set of partial motion vectors each associated with a corresponding subsampled matchblock representing a given picture;

coupled to the means for determining, means for generating a second motion vector based on a refined granularity of the preliminary motion vector; and

coupled to the means for generating, means for performing a fractional pixel search using the second motion vector to produce a final motion vector, the final motion vector being used for motion

compensation.

44. The video processing system according to Claim 43, wherein the means for determining a preliminary motion vector, comprises:

means for dividing the matchblock associated with the given picture into a plurality of first sub-blocks;

means for dividing a search area associated with a reference picture into a plurality of second sub-blocks, the second sub-blocks being divided by a factor similar to that used to divide the first sub-blocks;

means for duplicating one of the first sub-blocks over each of the second sub-blocks; and

means for determining a set of best matches between a respective sub-image in each of the first sub-blocks and a sub-image in each corresponding one of the second sub-blocks, the set of best matches representing the set of partial motion vectors.

45. The video processing system according to Claim 43, wherein the means for generating a second motion vector based on a refined granularity of the preliminary motion vector, comprises:

means for obtaining the matchblock associated with the given picture;

means for enlarging a first search area to generate a second search area, the first search area being associated with a reference picture and

used to determine the set of partial motion vectors; and

means for determining a best match between a respective sub-image located in the matchblock and a sub-image that is identical to the respective sub-image and that is located in the second search area, the best match representing the second motion vector.

46. The video processing system according to Claim 43, wherein the means for performing a fractional pixel search using the second motion vector to produce a final motion vector, comprises:

means for obtaining the matchblock associated with the given picture;

means for enlarging a first search area to generate a second search area, the first search area being associated with a reference picture and used to determine the second motion vector;

means for determining a half-pixel predicted reference macroblock associated with the second search area; and

means for determining a best match between a respective sub-image located in the matchblock and a sub-image that is identical to the respective sub-image and that is located in the second search area, the best match representing the second motion vector.

47. A video processing system capable of providing motion compensation, comprising:

array means for processing data received from memory means to

determine a motion vector;

coupled to the array means, means for selectively controlling the array means to enable processing of the data received; and

coupled to the array means, end column means for obtaining the motion vector from the array means to enable motion compensation.